News from Swift

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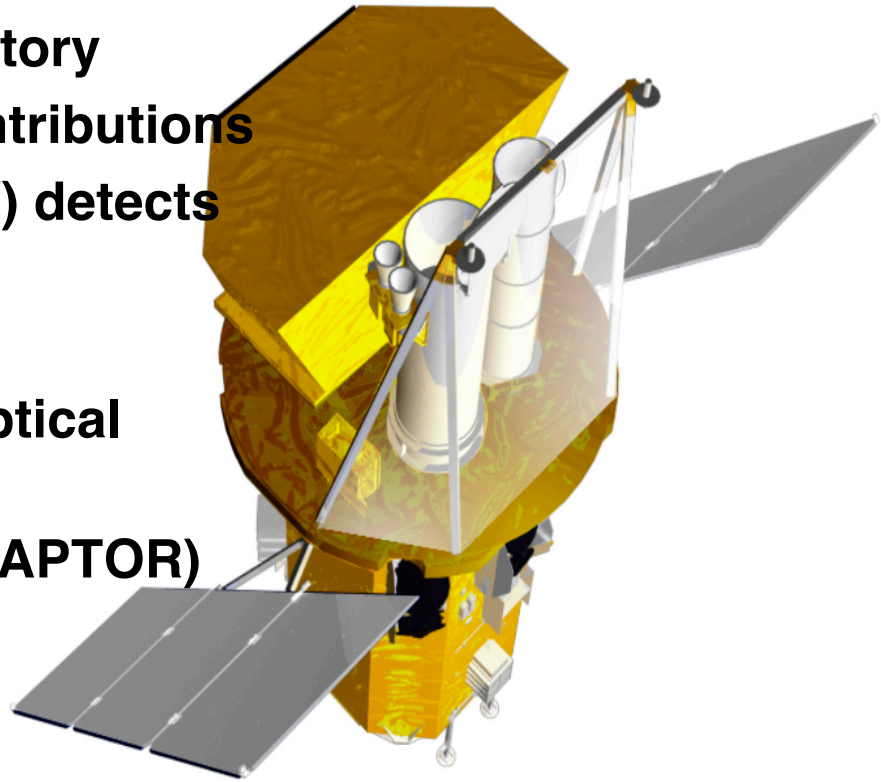
LANL Cosmology Day

April 15, 2005

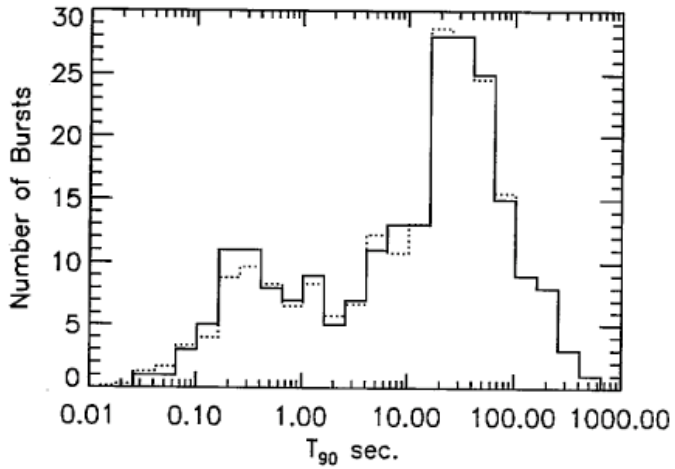
Swift Overview

- Launch November 20, 2004
- Gamma Ray Burst (GRB) Observatory
- NASA funding, with European contributions
- Burst Alert Telescope (15-350 keV) detects and locates GRBs (~6 seconds)
- Spacecraft slews to point to GRB
- X-Ray Telescope (XRT) and UV-Optical Telescope (UVOT) follow-up
- Instruments on the ground (e.g. RAPTOR) immediately notified

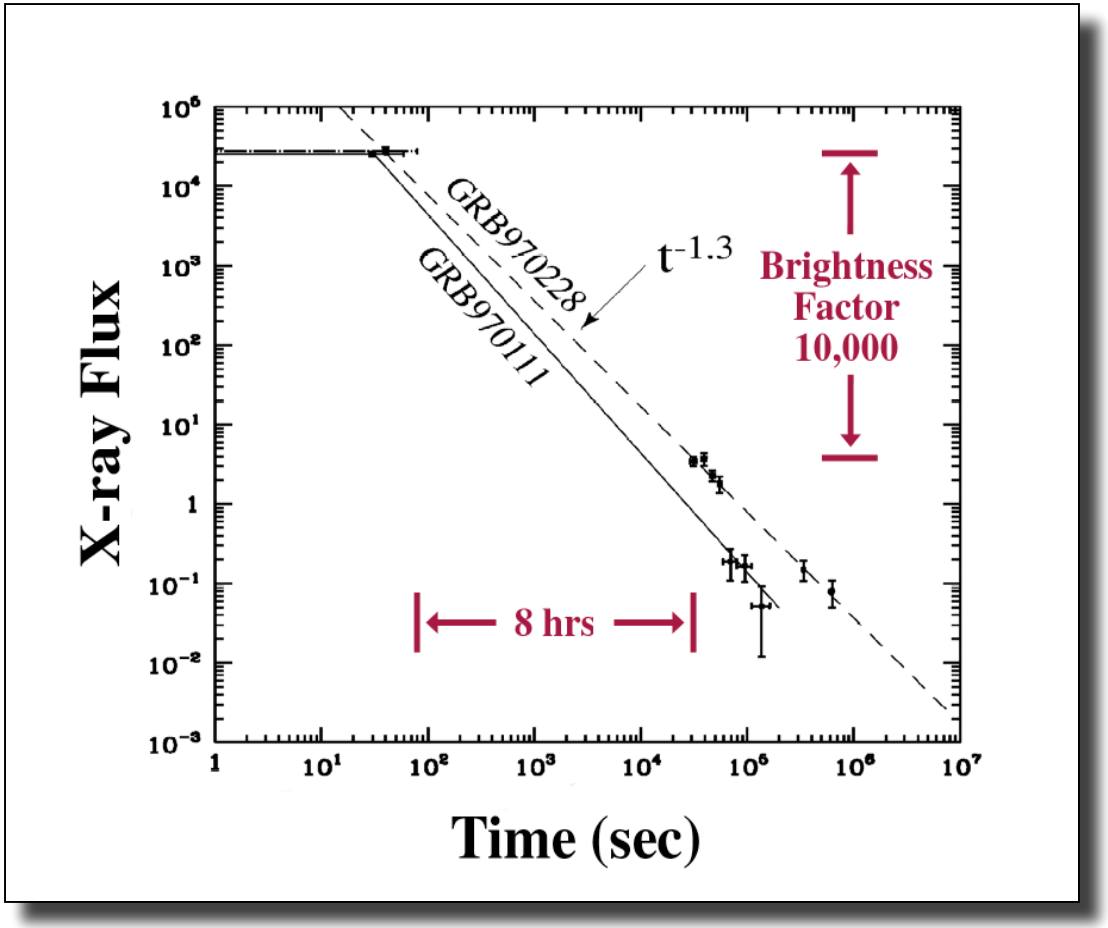


Gamma Ray Bursts

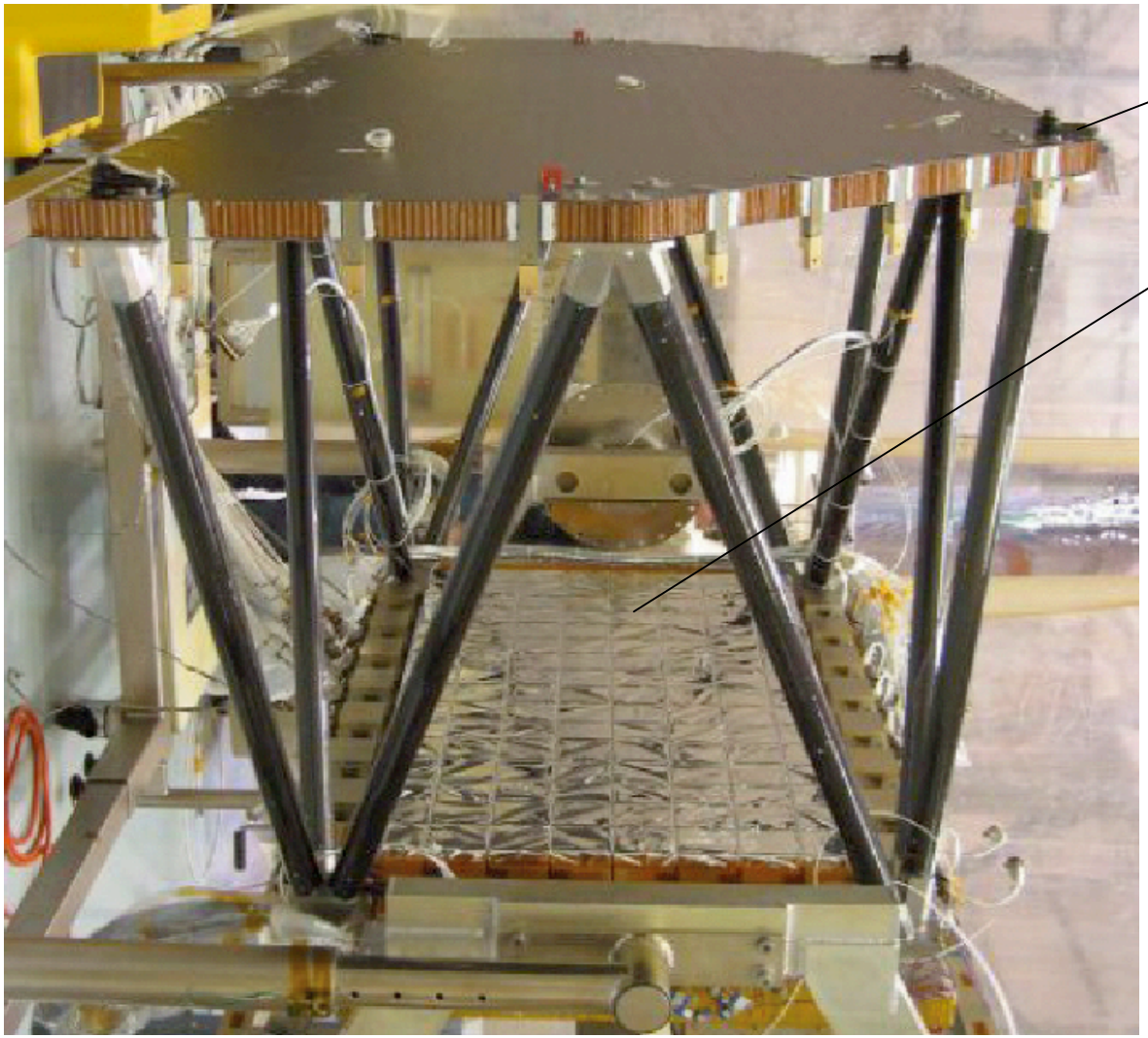
- **Biggest explosions in the Universe**
  - **~10^{53} ergs/10 seconds (isotropic equivalent)**
  - **Peak emission 0.1-1 MeV**
- **Huge variety of time behaviors**
- **Durations milliseconds to minutes**
  - **Bimodal--Long and short bursts**
- **Long GRBs found in star-forming regions in distant galaxies (Z~1 or larger)**
- **Nobody knows where short ones are found (yet)**



GRB Data "Gap"



Beppo-SAX took at least 6-8 hours to perform an afterglow follow-up observation with its narrow field instruments, and only saw about 10 bursts per year.



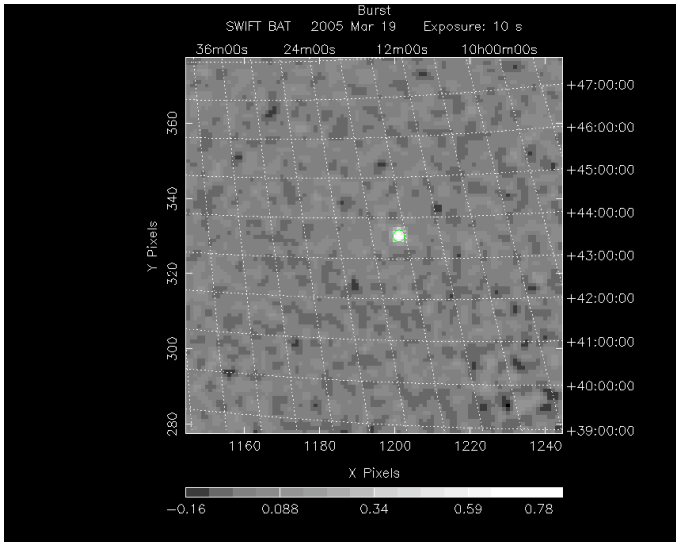
Mask

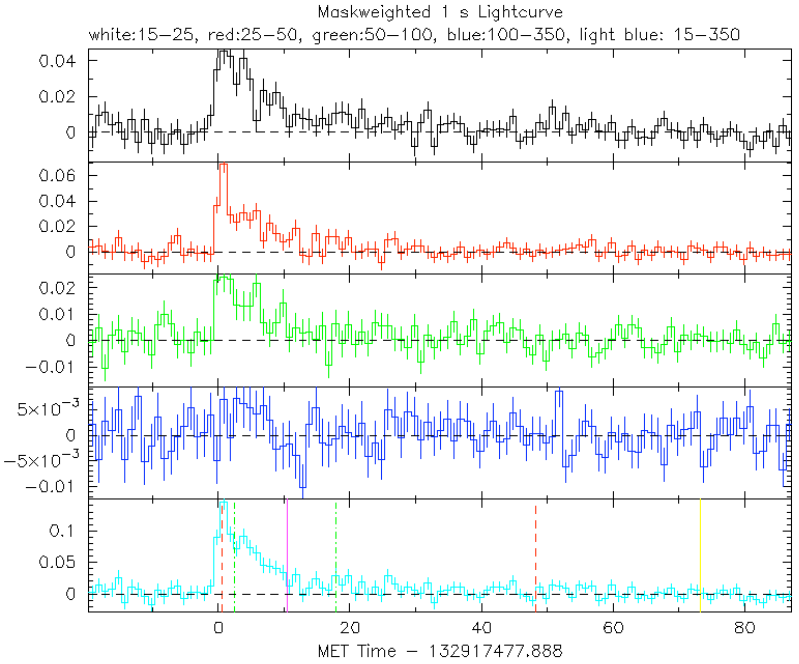
Detector Plane
32,768 CdZnTe detectors

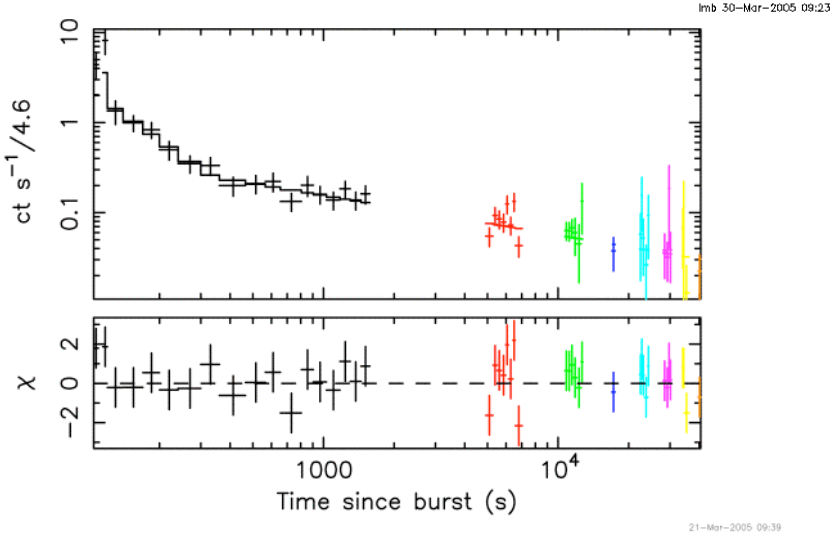
The BAT mask

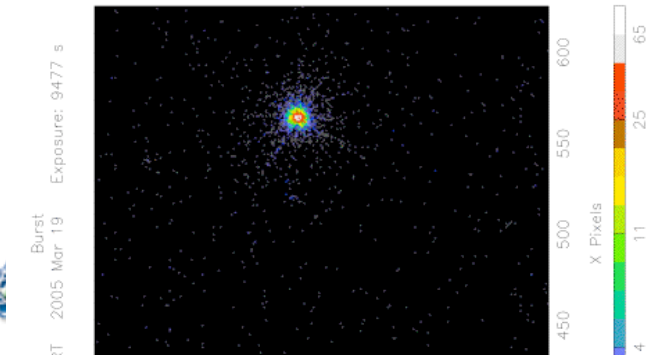
Swift sees GRBs

- 31 so far detected and located
- Many more det. but not located









Burst Reports

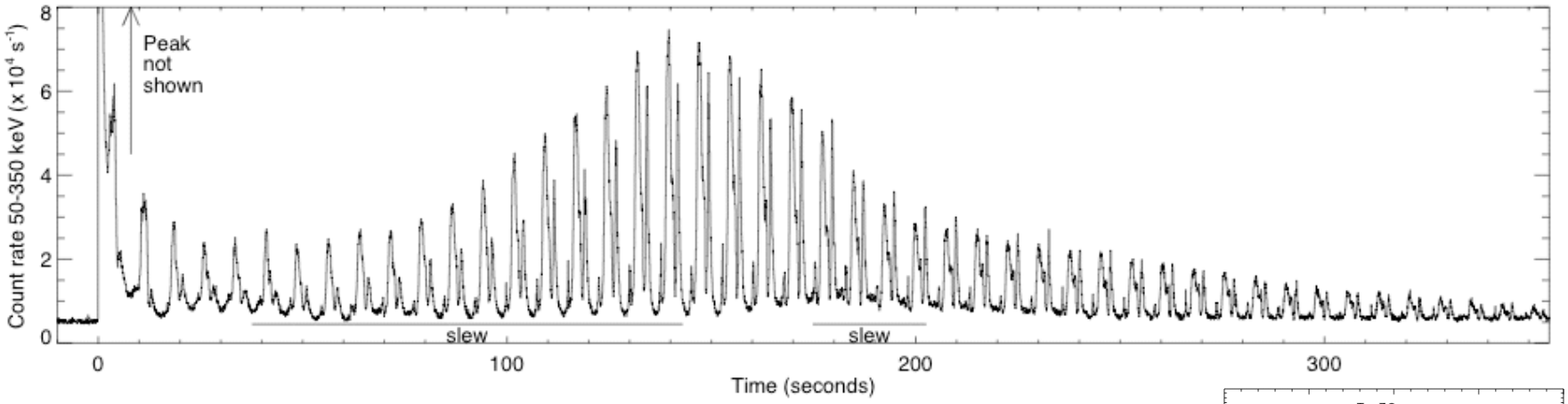
Date/DOY	Burst Name	Trigger Number	Link	Description
DEC 17 2004/352	GRB 041217	100116	Report/GRB041217	First BAT imaged GRB
DEC 19 2004/354	GRB 041219a	100319	Report/GRB041219	BBOY
DEC 19 2004/354	GRB 041219b	100367	Report/GRB041219b	Second burst in one day
DEC 19 2004/354	GRB 041219c	100380	Report/GRB041219c	Third burst in one day
DEC 20 2004/355	GRB 041220a	100410	Report/GRB041220a	Short burst or maybe LXB flare
DEC 20 2004/355	GRB 041220b	100433	Report/GRB041220	Fred Burst
DEC 23 2004/358	GRB 041223	100585	Report/GRB041223	Long hard burst
DEC 24 2004/359	GRB 041224	100703	Report/GRB041224	Long soft burst
DEC 26 2004/361	GRB 041226	100815	Report/GRB041226	Weak burst
DEC 28 2004/363	GRB 041228	100970	Report/GRB041228	Long burst
JAN 05 2005/005	GRB 050105	101581	Report/GRB050105	Very Weak Burst (Marginal)
JAN 17 2005/017	GRB 050117	102861	Report/GRB050117	Long multi-peaked burst
JAN 24 2005/024	GRB 050124	103647	Report/GRB050124	Double-peaked strong burst
JAN 26 2005/026	GRB 050126	103780	Report/GRB050126	Twenty second spikey burst
JAN 28 2005/028	GRB 050128	103906	Report/GRB050128	15-second spikey burst
FEB 02 2005/033	GRB 050202	104298	Report/GRB050202	Short GRB
FEB 15 2005/046	GRB 050215a	106106	Report/GRB050215a	'A' & 'B' real GRBs
FEB 15 2005/046	GRB 050215b	106107	Report/GRB050215b	'A' & 'B' real GRBs
FEB 19 2005/050	GRB 050219a	106415	Report/GRB050219	Long duration GRB
FEB 19 2005/050	GRB 050219b	106442	Report/GRB050219b	Second burst of the day!
FEB 23 2005/054	GRB 050223	106709	Report/GRB050223	20 second spikey burst
MAR 06 2005/065	GRB 050306	107547	Report/GRB050306	Long burst
MAR 15 2005/074	GRB 050315	111063	Report/GRB050315	Double-FRED burst
MAR 18 2005/077	GRB 050318	111529	Report/GRB050318	
MAR 19 2005/078	GRB 050319	111622	Report/GRB050319	
MAR 26 2005/085	False alarm	112438	Report/Trigger112438	
2005:085 (Mar26)	GRB050326	112453	Report/GRB050326	A bright multi-peak burst
2005:090 (Mar31)	False alarms	112977, 112981, 112982	Report/3FalseTriggers	Swift attitude problem (3 false alarms)
2005:091 (Apr1)	GRB 050401	113120	Report/GRB050401	2 peaked long big burst
2005:096 (Apr6)	GRB 050406	113872	Report/GRB050406	
2005:098 (Apr8)	GRB 050408	HETE 3711, 20004	Report/GRB050408	
2005:100 (Apr10)	GRB 050410	114298, 114299	Report/GRB050410	Long broad GRB
2005:102 (Apr12)	GRB 050412	114485	Report/GRB050412	

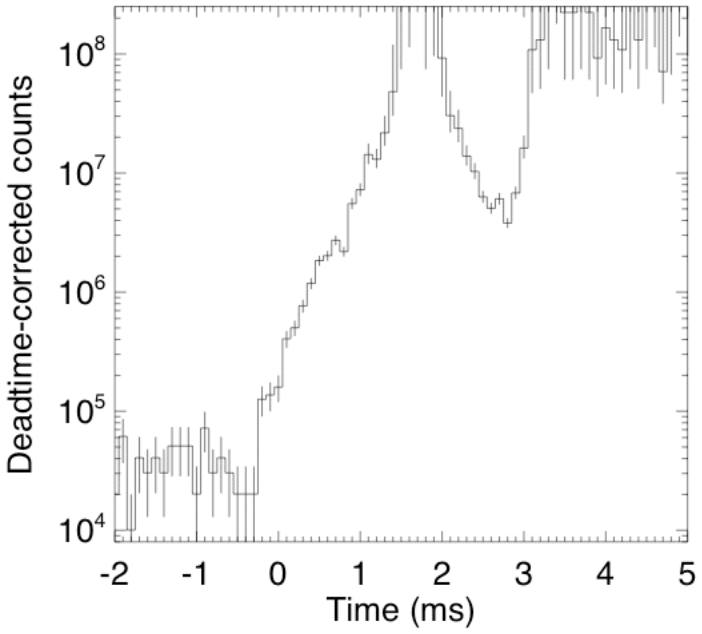
Los Alamos

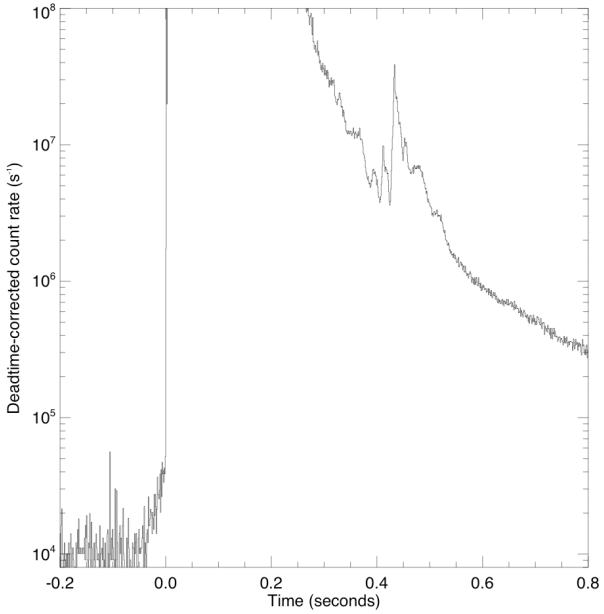
SGR 1806-20

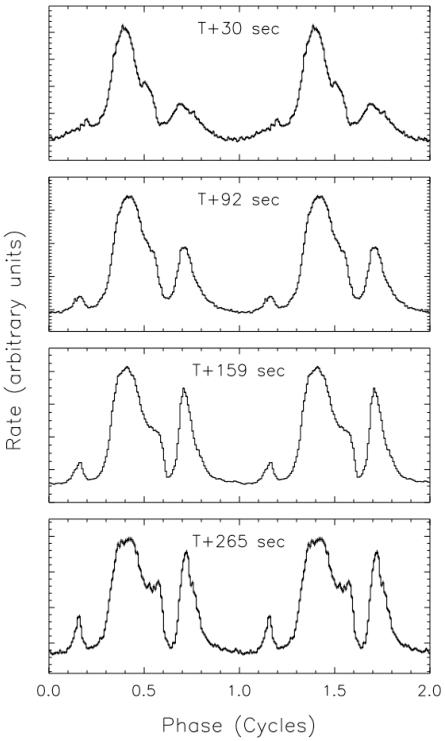
- December 27 Giant Flare (about 5 weeks after launch)
- Brightest (apparent) source ever seen from outside solar system
  - 0.8 ergs/cm^2/s above 45 keV for 160 ms
  - Several times brighter than Full Moon
  - 15 kpc away
- Soft Gamma Repeater
  - Very high magnetic field ~10^{15} G
  - ~4 known
  - Many small bursts (up to dozens per day when most active)
  - Rare Giant Flares (3 in 30 years)
- 100x as luminous as two previous Giant Flares
- 2x10^{46} erg~10% of total magnetic field energy
- Would be visible as short/hard GRB out to 40 Mpc
- Slew of *Nature* and other papers in coming weeks

SGR 1806-20


Peak
not
shown
Count rate 50-350 keV (x 10⁴ s⁻¹)
slew
slew
Time (seconds)


Deadtime-corrected counts
Time (ms)


Deadtime-corrected count rate (s⁻¹)
Time (seconds)


T+30 sec
T+92 sec
T+159 sec
T+265 sec
Rate (arbitrary units)
Phase (Cycles)

Other Swift news

- BAT performance excellent, much better than expected
- Typical position accuracy for GRBs is ~1 arcminute
  - Promise was 4 arcminutes
- ~100 GRBs/year
- Sensitivity is as predicted
  - Many new and previously-known persistent sources seen routinely
- Energy range is better than expected, down to ~12 keV
- XRT has thermal problems
  - Some restriction of operations, but not dire

- All data is now public, so the floodgates are open